

Claims

1. A method of forming a catheter tapered distal tip comprising:
providing a polymer catheter shaft having proximal and distal ends,
a distal tip adjacent to and including the distal end and a forming region on the distal tip that is to become tapered,
temporarily placing thermally insulative material segments over regions of the shaft immediately proximal to and distal to the forming region,
grasping the shaft at locations proximal and distal to the forming region,
heating the forming region sufficiently so that it may be plastically reformed,
placing the forming region in tension by pulling axially in opposite directions at the grasping locations,
removing the thermally insulative material.
2. A method as defined in claim 1 wherein the thermally insulative material applies a radial compressive force on the shaft.
3. A method as defined in claim 1 wherein the thermally insulative material comprises polyolefin shrink tubing.
4. A method as defined in claim 1 further comprising the step of inserting at least one forming mandrel into a lumen of the shaft.
5. A method as defined in claim 1 wherein the step of placing the forming region in tension is performed at least in part by an automated mechanical device.

6. A method as defined in claim 1 wherein the shaft is placed in tension by moving the grasping locations apart by a known distance at a known rate of travel.

7. A method as defined in claim 6 wherein the distance is approximately on the order of .72 inch and the rate of travel is in the range of approximately between .172 inch per second and .414 inch per second.

8. A method as defined in claim 1 wherein the catheter is a multilumen papillotome catheter having a cutting wire adjacent to its distal end and
further comprising the steps of skiving a hole into the shaft to expose an opening to a lumen of the shaft,
placing a cutting wire through a dedicated cutting wire lumen of the shaft and through the skive;
securing a distal end of the cutting wire in the cutting wire lumen distally of the skive hole while leaving a portion of the cutting wire exposed from the lumen over the skive.

9. A method as defined in claim 8 wherein a thermally insulative material segment is placed over the skive hole during heating.

10. A method as defined in claim 8 further comprising installing a radiopaque marker in a lumen of the shaft.

11. A method as defined in claim 10 wherein reducing the size of the anchor and marker serve to permit reduction of the length of the distal tip of the catheter.

12. A method as defined in claim 1 wherein the heating step comprises applying hot air to the shaft at approximately 700° F at a flow rate of approximately 20 to 30 cfm and for a time of approximately 40 seconds.

13. A method as defined in claim 1 wherein the distal end of the shaft to be tapered has been previously reduced in diameter in a necking process by drawing the shaft through a hot die.

14. A catheter having a low profile, short, tapered distal tip comprising:
a shaft having proximal and distal ends, a distal terminus and at least one lumen sized to receive a .035 inch guidewire,
a distal tip having a tip diameter measuring less than approximately .063 inch; and
a taper length of approximately 3 millimeters or less.

15. A catheter as defined in claim 13 wherein the catheter is a papillotome having multiple lumens and a cutting wire extending through at least a portion of one of the lumens and terminating adjacent to the distal tip.

16. A catheter as defined in claim 14 wherein the cutting wire exits the lumen along a portion of the shaft and reenters the lumen through a distal skive hole at a point adjacent the distal tip of the shaft ;
a tip length is defined between the distal skive hole and the distal terminus measuring approximately 5 millimeters or less; and
the taper is positioned between the skive hole and the distal terminus.

17. A catheter as defined in claim 15 further comprising a radiopaque marker at the distal tip.

18. A catheter as defined in claim 16 wherein the radiopaque marker is contained in the lumen occupied by the cutting wire.

19. A catheter as defined in claim 14 wherein the shaft comprises three lumens.

20. A catheter as defined in claim 14 wherein the tapered portion is formed by the steps of:

temporarily placing thermally insulative material segments over regions of the shaft immediately proximal to and distal to the tapered portion region,

grasping the shaft at locations proximal and distal to the tapered portion region, heating the tapered portion region sufficiently so that it may be plastically reformed,

placing the tapered portion region in tension by pulling axially in opposite directions at the grasping locations,

removing the thermally insulative material

21. A catheter as defined in claim 14 wherein the shaft has previously undergone a diameter reduction through a necking operation.

22. A catheter as defined in claim 19 wherein at least 2 lumens extend to and open to the distal terminus of the catheter.

23. A catheter as defined in claim 14 wherein, the tip diameter measures in the range of approximately .055 inch to .063 inch.

24. A catheter as defined in claim 14 wherein the tip diameter measures approximately .059 inch or less.

25. A method of cannulating the Papilla of Vater with a papillatome catheter and navigating the catheter in the common bile duct comprising:

providing a papillatome catheter having a short, tapered distal tip;

inserting the papillatome catheter into the Papilla of Vater and advancing the distal tip into the common bile duct; and

navigating the distal tip through the intraluminal segment into an intended branch selected from the bile duct and pancreatic duct.